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THE MECHANICAL VERSUS THE STATISTICAL INTERPRETATION OF NATURAL LAW.

IN recent idealistic philosophy there has appeared an instructive divergence of view with regard to the interpretation to be given to the conception of a law of nature. This difference becomes of especial interest when it is seen to follow as a consequence of an important disparity in the philosophic methods employed by writers who profess common allegiance to the name and principles of idealism.[1] On the one hand, there appears among certain representatives of idealism a tendency to seek truth by withdrawal from the external world to inner consciousness as to a center; and with this there also goes the abandonment of external nature in a measure to the contingent and the inexplicable. On the other hand, there are idealists who look outward rather than inward, who seek truth and values as objective in the actual world, and assume the real to be everywhere the rational. In this paper it is proposed to direct attention to the conflicting views of these writers only in so far as their views find expression in opposing interpretations of natural law. It will be seen that this opposition shows itself in essentially divergent interpretations of nature, leading on the one hand to a statistical view of natural law and on the other to a conception that is in principle mechanical.

The statistical view, as found in Ward and Royce, may first be examined. These writers assert the statistical character of natural law in two senses: first, that natural laws as formulated by the sciences are constructions of subjective consciousness; and second, that they also represent real processes of external nature. The view that natural laws are fundamentally subjective, are the methodological fictions of science, is familiar enough. Most of the laws formulated by science are admittedly no more than rough approximations to the real processes of nature. They are only "present methods of bookkeeping, convenient conceptions whereby we summarize observed facts. . . . But they are not . . . known to express anything final."[1] Furthermore, most scientific laws are based on averages struck from large numbers of facts taken together, and claim to hold true only with a certain probability as regards any particular case. "Many of the constants of science," says Ward, "are of the nature of statistical averages."[2] And Royce, affirming the statistical character of scientific knowledge, declares that it is the "type all of the organic and social sciences, as well as most aspects of the inorganic sciences, illustrate;" and that he finds it "hard to exaggerate the importance of those methods and of those ideas of natural science which are definable in terms of approximation and of probability."[3] Recognition by these thinkers of the statistical character of scientific law is due in part no doubt to their knowledge of recent science.[4] Within the past century, success has been claimed for statistical methods in widely varied fields, such as kinetics, molecular physics, biology, meteorology and economics.[5] All these sciences deal with data collectively; their laws are said to be rough averages struck from large collections of facts and to hold true only approximately and with a certain degree of probability in any individual instance. On the other hand, these thinkers in affirming the purely statistical nature of scientific law are no doubt partly influenced by their metaphysical prepossessions. Both Ward and Royce are convinced, on metaphysical grounds, that the world is ultimately composed of freely acting individuals. Hence they are forced to seek an explanation for the fact that science ignores such freedom and individuality and deals almost exclusively with constants and uniformities. The explanation ready at hand is that scientific laws are statistical and subjective in character. In adopting this interpretation, these thinkers abandon the claim that scientific laws represent concrete individual things as they are. On the contrary, they emphasize as the peculiar virtue of statistical laws that they lend a convenient semblance of regularity to facts which are in their nature of very different character. Statistical methods can generate the appearance of uniformity from groups of the most varied and changing particulars. This is clearly evident in the social sciences; in this field the laws ignore the peculiarities of individuals, leaving room beneath for a wide play of spontaneity and contingency. Similarly, the laws of other sciences, being statistical constants, never express the exact truth with regard to any particular case. They are pragmatic devices which serve to make a disorderly collection march in a regular manner. But their subjective and abstract character should never be forgotten, nor these rough averages mistaken for objective laws of nature or for exact descriptions of concrete fact.

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[1] *Cf.* J. E. Creighton, "Two Types of Idealism," PHILOSOPHICAL REVIEW, Vol. XXVI, pp. 514–536.

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[1] J. Royce, *The World and the Individual,* 2d ser., pp. 215–216.

[2] J. Ward, *The Realm of Ends,* p. 66.

[3] Royce, *Science,* Vol. XXXIX, p. 562, p. 559.

[4] In particular both are indebted to the views of Clerk Maxwell.

[5] *Cf.* Merz, *History of European Thought in the Nineteenth Century,* Vol. II, Ch. XII. It is indeed striking to find scientists in such widely separated fields as physics and biology—the sciences of matter and of life—alike claiming the use of statistical methods. Clerk Maxwell, speaking for physics, says, "If the molecular theory of the constitution of bodies is true, all our knowledge of matter is of a statistical kind." (Campbell and Garnett, *Life of James Clerk Maxwell,* p. 439. Quoted by Merz, Vol. II, p. 600.) In other words, if modern physics is right in holding that the smallest bit of matter we know, is composed of millions of imperceptible particles in motion, then it is maintained, all our knowledge of matter must be collective and statistical. Turning to biology, we find Galton, one of the first men to apply statistical methods to problems of heredity and variation, declaring: "The word man, when rightly understood, becomes a noun of multitude, because he is composed of millions, perhaps billions, of cells, each of which possesses in some sort an independent life. The doctrine of Pangenesis [originally formulated by Darwin] gives excellent materials for mathematical formulas, the constants of which might be supplied through averages of facts." *Hereditary Genius,* 1892, pp. 349–350. Quoted by Merz, Vol. II, pp. 612 ff.

At the same time, a statistical tendency is regarded (not without inconsistency) as a process in external nature. In the words of Royce, there appear to be "literally verifiable but not literally constant laws of observable Nature."[1] These laws seem undefinable in mechanical terms, yet can be expressed as statistical tendencies. And Professor Ward apparently concurs, citing from Lotze a statement that statistical formulæ, while inexact with regard to particulars, "can yet claim to express the *true law of history* as freed from disturbing individual influences."[2] Royce further develops this idea of the statistical character of historical progress. The well-known disposition to explain human history in terms of 'historical tendencies' and 'historical forces,' he believes has long testified to the inexact and unconscious use of statistical methods. "In fact," declares Royce, "the term *tendency* is, in every exact usage which you can give it, an essentially statistical term. To say that *a* has a tendency to lead to *b* is to declare that a more or less certainly and definitely known proportion of events of the class *a* are followed by events of the class *b*."[1] All the sciences which deal with tendencies (in other words, with 'forces,' with growth and evolution) are then essentially statistical. Moreover, it is claimed that their statistical principles reach beyond mere subjective validity and "go down to the roots of that nature of things which our sciences are studying."[2]

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[1] *The World and the Individual,* 2d ser., p. 223.

[2] *Naturalism and Agnosticism,* 3d ed., Vol. I, p. 111. Italics mine. For Ward, of course, "the actual is wholly historical." *Op. cit.,* Vol. II, p. 281.

Because he believes that statistical knowledge, though "only probable and approximate," is somehow "positive" and grips the objective nature of things, Royce holds that it is the ideal method of scientific enquiry. "The statistical form," he says, "is the canonical form of scientific theory."[3] Discovery of the wide range and use of statistics marks the greatest advance in inductive method. Statistical results interpreted by the laws of chance can furnish definite conclusions with a certain probability of truth with regard to any set of facts in the universe. The method for arriving at such statistical knowledge Royce calls "the Organized Combination of Theory and Experience."[4] All that is necessary in order to employ this method is to assume that the set of facts to be examined has a *determinate constitution,* and then to 'sample' the collection of them. Once we "grant the single principle of the determinate constitution of any finite set of facts of possible experience, we can draw probable conclusions regarding the constitution of such a set of facts, in case we choose 'fair samples' of this collection."[5] The 'fair sample' is explained

[1] Royce, *Science,* Vol. XXXIX, p. 559.

[2] *Ibid.*

[3] *Ibid.,* p. 562.

[4] *Encyclopædia of the Philosophical Sciences,* Vol. I (Logic), Eng. trans., p. 78. The name is somewhat confusing, yet at least distinguishes this procedure from the traditional statistical methods of logical text-books. It remains, in spite of its use of hypothesis, essentially a statistical method.

[5] *Op. cit.,* pp. 83–84.

simply to be any member selected at hazard (*i.e., without any particular reason*) from a large collection. By the magic of this simple procedure, we can obtain positive (although only probable and approximate) knowledge concerning any facts within the breadth and scope of experience. "It is possible to judge by samples the probable constitution of otherwise unknown cargoes of wheat or of coal, the general characteristics of soils, of forests, of crowds of people, of ores, of rubbish heaps, of clusters of stars, or of collections of the most varied constitution."[1]

In spite of these statements and others of a similar character which might be quoted, I believe that examination proves that Royce's canonical form of statistical method is not really a method by which science can grasp literal and objective truths of nature. In the first place, Royce, although he has previously rejected the Uniformity of Nature as a guide to inductive knowledge,[2] here claims as the *sole necessary postulate* of his method the granting of a 'determinate constitution' to the set of facts to be examined. But the postulates of uniformity and 'determinate constitution' would seem to come to the same thing. Secondly, a fundamental postulate of the method of which no mention is made, is the assumption that the law of chance is objective, that if a collection be large enough, in the 'long run' the 'sampling' will yield the character of the whole collection. This assumption makes 'chance,' 'indefinite quantity,' and 'ignorance' the grounds of knowledge.[3] Chance figures as a fundamental concept in a method based on the selection of samples at hazard. Indefinite quantity appears in the concepts of the 'long run' and the 'large collection.' Ignorance of any definite ground is made a principle of selection, in the assurance that a sample of facts chosen *without any particular reason* will be a fair one. Now we are surely justified in rejecting a method which bases knowledge on concepts that exclude the very form of knowledge. Such cannot be the canonical form of scientific theory. And while application of such a method might elicit certain useful results with regard to the numerical proportion of factors in a simple aggregation of instances, it could furnish no real understanding of more complicated, organic collections, where the information sought is rather qualitative and concerns the relation of parts within a concrete system.

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[1] *Ibid.*, p. 84.

[2] *Ibid.*, p. 82.

[3] *Cf.* the writer's monograph on *Some Modern Conception of Natural Law* (Cornell Studies in Philosophy, No. 12), p. 77, Longmans, Green, 1920.

According to Ward and Royce, a statistical tendency is the leading character of evolution as a process in external nature. As expressed by these writers, the dominant feature of evolution is a tendency to 'mutual assimilation,' to a 'fecundity of aggregation'[1] and 'integration of new properties in the whole.'[2] This integrative impulse of nature seems to express itself as a statistical progression. Phenomena assimilate to each other with a frequency roughly in accord with probability and the laws of chance. The direction of the statistical process is away from chance toward organization; and organization is a concept weighted with a teleological significance. According to Ward, "The process throughout is that of trial and error. . . . Contingency . . . is inevitable. . . . Still through all a steady tendency is apparent to replace this mere contingency by a definite progression. . . . With this progression we are familiar under the name of evolution. . . . What is thus created are not new entities but new values."[3] The process of evolution is then an integrative tendency away from chance toward order and values. Progress is by natural selection,[4] yet the unknown goal or goals of the process are assumed to have teleological significance. Royce sums up this view of evolution in more detail: "In brief, the evolution of stars, of elements, of social orders, of minds and of moral processes, apparently illustrates the statistical fecundity of nature's principal tendency—the tendency to that mutual assimilation. . . . Now it is this principle of the fecundity of aggregation which seems to be the natural expression, in statistical terms, for the tendency of nature towards . . . a purposiveness whose precise outcome no finite being seems precisely to intend."[1] According to such accounts, the bridge from chance to teleology seems to be a statistically definable natural selection. This statistical tendency is further described as a disposition toward mechanization.[2] However, evidences of mechanization do not imply that nature is mechanical, according to these thinkers; they rather imply that it is personal in character. Tendencies to mechanism in the physical world are oddly explained as nature's 'habits' and lapses from consciousness into automatism. The "routine and uniformity" of nature, says Ward, can be "explained on the analogy of habit and heredity in the individual;" and he quotes approvingly the words of C. S. Peirce that "matter is effete mind, inveterate habits becoming physical laws."[3] Disregarding the personalistic implications in such an interpretation of nature, the point for our purpose is that nature is here described as tending away from consciousness toward automatism and dead routine. This introduces a new aspect of statistical evolution. The statistical tendency is now seen to involve a twofold process: on the one hand, the devolution of conscious purposes into irrevocable mechanisms, and on the other hand, the evolution of a teleological order out of contingency. The question might be raised whether these opposite interpretations of the statistical tendency can be reconciled in the systems under discussion. If the goal of evolution be the fulfillment of purpose, can it be achieved through the degenerations of purpose? Again it might be questioned whether the facts of science verify a statistical progression in nature, and whether the curious conception of natural laws as psychical acts that have become automatic is not too suggestive of personalistic preconceptions in metaphysics.

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[1] Royce, *Science,* Vol. XXXIX, p. 565.

[2] *The Realm of Ends,* p. 434.

[3] *Ibid.,* pp. 433–434.

[4] *I.e.,* by 'trial and error' and the "objective realization of adaptations that were never subjectively intended." *Op. cit.,* p. 79.

In the writings of Ward and Royce, four lines of argument may be distinguished which support the statistical view of nature and natural law. The first is based on the claim just discussed of a statistical progression in evolution; the second, on the assertion noted that the uniformities discovered by the leading sciences are in type statistical. The third is a group of arguments directed against the mechanical view of nature and offered—on the assumption of a strict alternative—as proof of the statistical view. This third group of arguments also brings up the point that a mechanical view would reduce the world to homogeneity, whereas it is only heterogeneity and qualitative difference which enable us to distinguish things from each other.[1] Moreover, the search for homogeneous elements leads to abstraction, and mechanism thereby fails to account for the rich variety of life and nature.[2] Lastly, these arguments charge that mechanical theories involve an unwarranted assumption, being based on an ideal of exactitude which experience never verifies. "Mechanical theories are in their essence too exact for precise verification," says Royce. "Hence, since they demand precise verification, we never know them to be literally true."[3] And Ward states the matter similarly: "In the exact sciences, within the limits of our powers and subject only to the laws of thought—we are complete masters of the situation. . . . But applied to the particulars of experience such conceptions have no warrant."[4] Mechanical theories, then, are not really true; they lay claim to an exactness never verified in fact, and thus are self-contradictory.

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[1] Royce, *Science*, Vol. XXXIX, p. 565.

[2] *The Realm of Ends*, p. 74; Royce, *Science*, Vol. XXXIX, p. 565.

[3] *The Realm of Ends*, p. 74. Royce also interprets signs of mechanism as 'habits' of nature. "This process of evolution will then lead from mere chance towards the similation of mechanism, from disorderly to a more orderly arrangement, not only of things and of individual events, but of the statistically definable laws of nature; that is, of the habits which nature gathers as she matures." *Science*, Vol. XXXIX, p. 565.

The fourth argument advanced in favor of the statistical view of nature and natural law is one first enunciated in principle by Clerk Maxwell,[5] and here cited in the form developed by Ward.[6] It is the argument from the analogy of physical laws to social statistics. On the assumption that statistics is the predominant method of the social sciences, it is claimed that it is similarly the chief method of physics. Statistical averages can hide, under a semblance of uniformity, the greatest variety in the individuals.

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[1] *Naturalism and Agnosticism,* 3d ed., Vol. I, p. 151.

[2] *Ibid.,* pp. 152–153.

[3] Royce, *Science,* Vol. XXXIX, p. 562.

[4] *Naturalism and Agnosticism,* 3d ed., Vol. I, p. 138.

[5] Campbell and Garnett, *The Life of James Clerk Maxwell,* pp. 438 ff.

[6] *Naturalism and Agnosticism,* 3d ed., Vol. I, pp. 109–111; *The Realm of Ends,* pp. 65–66, also p. 433.

The aggregates of the social sciences, for instance, conceal beneath them the diversity and spontaneity of animated beings. Now "the physicist, like the statist, is always dealing with aggregates, but unlike the statist he finds *the constituent individuals to be beyond his ken*."[1] The atoms and molecules of the physicist are too minute and their collections are too vast for separate study. But even though the particulars are beyond his ken, it is argued from analogy and the principle of continuity that the ultimate units of the physicist must be also unique, spontaneous agents. The conclusion is that the universe is made up throughout of such psychical individuals, acting in accordance with free will and contingency. And as conative agents and as sources of contingency, they must be studied as social phenomena, by means of the concepts of average, probability and approximation,—in other words by statistical methods.

The statistical character of the physicist's laws is often denied. The fact of this denial is explained by these thinkers as due to the character of the physicist's data. Because the constituent individuals with which he deals are beyond direct knowledge, the physicist often fails to recognize both that he is dealing with individuals, and that his laws are simply averages expressing the behavior of vast collections of individuals. Instead, he makes the mistake of regarding his statistical constants as iron necessities. This mistake is hardly to be wondered at in physics, says Professor Ward, since it occurs even in the social sciences, where the character of the data is less concealed. "Now, if, when both the varying particulars and the statistical constants are alike well-known [*i.e.*, as in the social sciences], it is possible for a reasonable man to fall into the error of converting the one into an iron necessity which rules over the other, no wonder this should be the prevalent attitude in departments of knowledge where the particulars are beyond our ken."[2] From this illusion of iron necessity there arises the physicist's mistaken belief in mechanism and a mechanical nature. Yet if he would only recall the similar methods of the social sciences, he would recognize his physical constants to be mere statistical approximations, holding only in general and not of each particular case. Thus the argument seeks at once to dispose of mechanism by substituting the statistical interpretation. Since statistical methods are employed in dealing with vital phenomena,[1] and since the phenomena we know best seem best studied in large collections, analogy would suggest that in physics (with much vaster collections) the same methods are actually employed; while the principle of continuity would lead on to the idea that physics is likewise concerned with what is vital and unique.

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[1] *Op. cit.*, p. 66. Italics mine.

[2] *Naturalism and Agnosticism*, 3d ed., Vol. I, p. 111.

Now, it is obvious that this whole line of argument rests on the assumption that the methods of physics are statistical *in the same sense* as are the methods of the social sciences. But this is just the point that may be seriously questioned. In social statistics, you are able to strike an average because you have direct access to the particulars, and knowledge of them. Averages are based on collections of real individuals. But in dealing with molecules, particles beyond direct experience, you cannot get a genuine average just because you do not have a collection of real individuals. In fact, the individuals as such are quite unknown, being *ex hypothesi* 'beyond our ken.' You cannot, then, talk about the 'average atom' in the same sense in which you can talk about the 'average man.' Strictly speaking, molecules are 'manufactured' articles, hypothetical constructs of the scientific imagination; and as such are not derived by generalization from experience as are genuine statistical constants. To a layman, the method implied by the molecular theory of matter would seem rather a hypothetical and a mechanical method than a statistical one. For, in the first place, the theory is apparently non-empirical and defines its units as homogeneous prior to experience; no attempt is made to learn the character of material particles by generalization from definite empirical collections. Secondly, no scope is left for the calculation of probabilities, such as would be required by a statistical method; instead absolute necessity is postulated *a priori* in the movements of the particles.

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[1] "The logic of the insurance actuary is essentially the same as the logic which is consciously or unconsciously used in dealing with all forms and grades of vital processes." Royce, *Science*, Vol. XXXIX, p. 558.

Dr. Bosanquet has subjected the argument from the analogy of physical laws to social statistics to a searching criticism. He maintains that the analogy is false, since in physical statistics, where we deal with minute particulars, it is impossible to get *true constants* such as are possible in social statistics. A true constant is an average derived from a *comparison of averages*; also it is an average based on *groups that in some way differ.*[1] Such averages are possible in social statistics, where individuals are capable of separate measurement and where also the groups selected for examination may differ. But they are impossible in dealing with minute physical elements, which are *ex hypothesi* homogeneous. Hence the analogy between the kinds of statistics breaks down. While this criticism seems to me valid, I think it can be carried further. Dr. Bosanquet assumes that the physicist *can* arrive at an average representing minute physical elements. But it seems questionable whether there can be any real average of elements where the individuals are beyond separate measurement. The crux of the matter is neither that groups must be *compared* nor that they must *differ.* These are considerations connected with defining a law by the causal Method of Difference and are of secondary concern here. The essential point is that when physics undertakes to deal with minute physical elements, it enters apparently a realm where separate individuals are beyond measurement and beyond its ken. This renders it impossible that genuine averages or statistical methods like those of the social sciences should be employed.

As we have seen, Royce and Professor Ward have opposed mechanism on the ground that the variety and adaptation of our universe cannot be understood as resulting from the quantitative relations of homogeneous elements. Hence they have chosen a statistical view, referring the source of law to the activity of psychical individuals and to the laws of chance. The appearance of mechanism they "analyse," as Bosanquet remarks, "into degenerated finite teleology, on the analogy of secondary automatism."[2] Now, in spite of many points of divergence from these thinkers,

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[1] Bosanquet, *The Principle of Individuality and Value*, pp. 86–87.

[2] *Ibid.*, p. 142.

Dr. Bosanquet agrees with them in rejecting as inadequate the mechanical view which would reduce the world to homogeneous elements. Professor Ward has clearly shown in the first volume of *Naturalism and Agnosticism* that an uncritical mechanism in science leads to a self-refuting materialism.[1] Dr. Bosanquet is no less anxious to deny mere materialism, yet hopes to preserve mechanism by freeing it of the old spatial analogy and interpreting it more broadly in a 'sense akin to system.'[2] The essence of mechanism is not that the world consists of extension or physical substance. Rather, "the essence of it is that the world consists of elements, complete in themselves, and yet determined in relation to elements beyond them."[3] What matters is not the *kind* of element, but the fact that each claims to have a nature of its own, and that they are determined *ab extra* by relations. These are the characteristics of system. And if mechanism is system, then the nature of the elements is a secondary problem, to be settled by 'the plain probability of the facts.' The important point is that system assigns control to the content as a whole, and not to some bare directing force or element. Moreover, as system, mechanism implies unity in difference, a heterogeneity organized by relations, and not a collection of homogeneous elements.

Another charge brought against mechanism by Professor Ward and by Royce is that mechanism claims an exactitude in its laws never verified by experience. From the standpoint of concrete idealism, such a charge bespeaks a fundamental misunderstanding as to the nature of law. True, the ideal mechanical law is never exactly realized in the particular case. But this is because laws are universals; facts as such are particulars. Both remain themselves and are not interchangeable. The truth of mechanism implies that the *ideal* laws and the *facts* of experience are complementary; that there is 'equivalence' between them; but neither can be reduced to terms of the other. The unattainableness of the ideal law, then, means no more than that the ideal cannot be shorn of its ideality and reduced to common fact. The mechanical law remains the organizing principle, the informing ideality of facts, yet is itself no mere empirical fact.

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[1] *Naturalism and Agnosticism,* 3d ed., Vol. I, pp. 143–144 especially.

[2] Bosanquet, *Proceedings of the Aristotelian Society,* N. S., Vol. XII, p. 243.

[3] *The Principle of Individuality and Value,* p. 73.

One of the most interesting aspects of Dr. Bosanquet's view is his contention that mechanism is the only principle of law which preserves 'individuality and value' and the rights of the spirit. Here he challenges direct comparison with thinkers who, fearful of the logical consequences of the sciences, have urged that if the spiritual values are to be conserved, the world cannot be a mechanically intelligible whole. Accordingly, it has seemed necessary to discredit exact law and the Uniformity of Nature by citing instances of apparently irregular phenomena and the caprices of individuality. In opposition to this view, Dr. Bosanquet maintains that "it is the true spiritual view which regards Nature as mechanically intelligible."[1] For only a rationally organized world can sustain the existence of eternal values. Moreover, the principle of the rational order of nature is simply the principle of mechanism or of the Uniformity of Nature stated in the broadest terms. Mechanism or uniformity implies that nature is a system ordered in accordance with logical relevancy and causal connections. "The Uniformity of Nature is here taken as a logical postulate, equivalent to the Law of Identity as interpreted into the Law of Sufficient Reason."[2] It is only in such a mechanically concatenated world, that is, in one transparent to the law of causation or sufficient reason, that individuality, value and law itself can be realized.

In describing his conception of mechanism, Dr. Bosanquet calls attention to the fact that it implies a double relationship, involving both quantity and quality. He says: "The idea of mechanism here accepted is one which neither reduces the universe to modifications of homogeneous quantity, nor yet impeaches the 'uniformity of nature,' and the general quantitative relations underlying natural phenomena. It accepts as the apparent custom of the universe and as a corollary of the interdependence of content and system the principle that *qualities have quantitative connections*, and that a high degree of spiritual or emotional expressiveness accompanies a high degree of complexity and intelligible determinateness."[1] In such a statement, the mechanical principle is interpreted as involving the consistent correlation of quality with quantity. Sometimes Dr. Bosanquet distinguishes this view more particularly by the term 'equivalence.' By this he means that the type of relation found in individuals everywhere is one of *qualitative wholes in quantitative counterparts;* or, in other words, that "teleological wholes are inevitably constituted by what may fairly be called mechanical relations."[2] A concrete instance of the equivalence of the qualitative with the quantitative according to the mechanical principle is the equation of the comparative intensity of two colors with the relative amplitude of their ether waves. The qualitative and the quantitative are complementary, having in them the same principle; yet they remain arithmetically incommensurable and irreducible to homogeneous units. They can, however, be correlated as ratios, as in the example cited, where the intensities of the colors are proportional to the width of the ether waves. Equivalence also implies determination by the whole. Neither the psychical nor the physical can be the guiding force. Both the qualitative and the quantitative are compelled by the system in its entirety. It is always the Whole which operates upon the parts, and which, together with their response to its common logical principle, constitutes natural selection.[3]

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[1] *Op. cit.*, p. 140.

[2] *Ibid.*, p. 138.

Even to mind itself, Bosanquet says, "no injustice could be done by connecting it with a physical counterpart, and equating it with a sum of mechanical energy."[1] He repudiates the notion that consciousness is outside the range of mechanism or that it introduces a spiritual force antagonistic to natural law. "The mechanical appearance must be granted universal and unbroken."[2] Consciousness itself is essentially in its action "no more than a coöperative mechanical force."[3] In plain language he rejects the admixture of consciousness and chance utilized by the statistical view. "It is idle," says Bosanquet, "to appeal to finite purposive consciousness as . . . the source through its fossilized habits, of what is construed as a mechanical 'nature.'" "On the one hand, it is ridiculous to say that such a product [as a flower] arises *by accident;* that is, as a by-product of the interaction of elements in whose nature and general laws of combination no such result is immanent." "On the other hand, we must not say that 'purpose is operative' in the flower or the wave, if that is to mean that we ascribe them to an end or idea, somehow superinduced . . . by a power comparable to finite consciousness . . . out of a *detached spontaneity* of its own."[4] The purpose which Nature fulfils is an immanent one; it is latent in the whole universe and operates through the pressure of the total environment on the individual. Growth by this sculpturing-process of the Whole is what is signified by evolution or natural selection. Its law is mechanical in the sense that it is based on the principle of sufficient reason as translated into causation and the Uniformity of Nature.[5] To ascribe the work of natural selection to mere consciousness as such is absurd. Works like those of consciousness are achieved quite beyond the guidance of any consciousness as we know it, as for instance in the growth of a coral-reef colony or in the age-long developments of art and civilization.[6] No less absurd is the explanation of natural selection through laws of chance. Nature high and low gives us too strong an impression of systematic relevancy. The motions of the solar system, the curl of a wave, strike us as meriting a presumption of teleological value only less than that of consciousness itself.[1]

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[1] *Op. cit.*, p. 140. Italics mine.

[2] *Ibid.*, p. 161.

[3] Natural selection, on the statistical view, appears as a compound of the individual's conation, the particular environing obstacles and the laws of chance. On the mechanical principle, natural selection is described as the pressure of the total universe as brought to bear on the individual in any given situation. Its operation is through the law of causation, which viewed non-temporally is identical with the principle of relevancy or sufficient reason. Referring to natural selection as the power of direction exerted by the total universe, Bosanquet says: "The bearing and result of these considerations would be to lay greater stress on a factor which might be called in a very wide sense 'natural selection,' that is to say, on the moulding of the organic world, and even the world of mind, in relation to the environment which we know as physical Nature. . . . *The suggestion would be that the universe is, as a whole, self-directing.*" (*Op. cit.*, pp. xxiv–xxv. Italics mine.)

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[1] *Ibid.*, p. 178.

[2] Bosanquet, *Proceedings of the British Academy*, 1905–1906, p. 240.

[3] *The Principle of Individuality and Value*, p. 164.

[4] *Ibid.*, pp. 146–149. Italics mine.

[5] *Ibid.*, p. 119. "The Uniformity of Nature or principle of Relevancy means that every variation is a member in an intelligible system."

[6] *Ibid.*, p. 152.

In concluding this article, it may be recalled that for Royce and Professor Ward the type of law is statistical. This implies that the expression of the law is achieved through sampling large collections with the hope that in the long run (in default of any knowledge why variations should occur) all unknown causes will be included with equal frequency, thereby cancelling them; and approximate knowledge and uniformity will result. For Dr. Bosanquet, on the other hand, law embodies a mechanical principle under the form of equivalence. Equivalence correlates the qualitative phenomenon with its relevant quantitative conditions. The ideal of law is not to smooth over and compensate for the particular instance by losing it in a vast collection, but to correlate the particular individual with its intelligible conditions, thereby according it place and value in the whole system in accordance with relevancy or the Uniformity of Nature.

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[1] *Op. cit.*, p. 147.